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ABSTRACT

The 1972 Environmental Education for Guam Schools Project originated from the recognition of a need for environmental education on the island. The ultimate goal was to graduate citizens who were knowledgeable and conscientious about environmental concerns. This report describes and assesses the impact of this project on Guam and provides a source of feedback, a source of suggestions for further improvement, and a vehicle for dissemination of information. The report contains three categories of data--contextual data, program data, and evaluation data. Contextual data concern the economic and demographic factors of the locale and organizational and financial problems of the school system. Program data provide information on personnel, procedures, equipment, training, community involvement, and expenditures. The evaluation data focus on the behavioral objectives and goals, and instruments for measuring them. The final section, Conclusion and Recommendations, notes that the students in pilot schools developed an awareness of the need for, and interest in, preserving the environment. An overview of the curriculum adaptations, and a sample teacher evaluation sheet are included in the appendices. (Author/TK)

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ED099183

IMPACT OF ENVIRONMENTAL EDUCATION FOR GUAM SCHOOLS

An Evaluation

PREPARED FOR

THE DEPARTMENT OF EDUCATION

GOVERNMENT OF GUAM

JULY 1973

ANTHONY KALLINGAL

THIS EVALUATION WAS PREPARED WITH THE ASSISTANCE

OF

MR. DAVE HOTALING, DIRECTOR OF THE

ENVIRONMENTAL EDUCATION FOR GUAM SCHOOLS PROJECT

AND

MRS. LOU SAN NICOLAS, PROJECT SECRETARY

JULY 1973

ANTHONY KALLINGAL

EVALUATION REPORT

1.0 ABSTRACT

In September 1972, the Environmental Education for Guam Schools Project (EEGSP) was launched with funds available from ESEA Title III, in two schools on an experimental basis involving 527 students in grades one through six. The project originated directly out of the recognition of a need for environmnetal education on the island. The ultimate goal of graduating citizens knowledgeable and conscientious about environmental concerns shaped the layout of the project components and implementation details.

Prior to implementation in the classroom, two project procedures occurred concurrently: adapting SCIS to render it applicable to Guam, and training of teachers on Guam's ecology. In the classroom, instructional strategy underlined the principles of student planning and involvement, of independent activities - principles designed to promote not only growth in knowledge but also desirable conservation attitudes. Outdoor activities were continually emphasized.

Evaluation design compared the intellecut[illegible] achievements of pilot students with comparable control groups a[illegible] measured by locally developed and validated tests. The comparability was established on the basis of performances on pre-test[illegible] on which, in every grade, the average score of control students was higher than that of pilot students. On post-tests 1st, 2nd, 3rd and 5th graders in the pilot schools surpassed significantly the performance of control students while pilot 4th and 6th graders showed a slight increase over the control students in the average of test scores.

The attitudinal growth of pilot students was assessed on the basis of percentage of students reaching predetermined levels of acquisition. In every grade the expected outcome was that 75% would receive better than average ratings from teachers on the four attitude factors of curiosity, inventiveness, critical thinking and persistence. Three of the six grades reached the expected mark, while the other three fell slightly below. In addition, teacher remarks showed that the students in the pilot schools developed an awareness of the need for and interest in preserving our environment.

The cognitive and affective accomplishments of the pilot students as well as the general satisfaction of teachers with the curricular materials and instructional strategies of the adapted SCIS indicate the desirability of program expansion and of systemwide adoption of environmental education on the island.

2.0 INTRODUCTION

The purpose of this report is to briefly describe and assess the impact of the Environmental Education on Guam. The report provides data useful for educational decision makers. It also serves as feedback to the project staff on their activities during the year of program implementation and as a source of suggestions for further improvement of the project. The report serves as a vehicle for dissemination of information regarding the Environmental Program to an interested audience.

The report contains three categories of data: contextual data, program data and evaluation data. Contextual Data concern the demographic and economic factors of the locale, organizational and financial problems of the school system and special factors that provided the need for and led to the establishment of Environmental Education on Guam.

The section on Program Data seeks to provide the reader with the information of who did what, and how. This information could be useful in determining the exact nature of the intervention variable (Research Purpose) and in suggesting ideas for replication and/or modification, (Development Purpose). Here attention will be directed to scope of the program, personnel involved, procedures such as curriculum development, teacher training, instructional equipment and materials, community involvement, and finally a brief layout of expenditures.

The section on Evaluation Data is the core of this report. The previous two sections lead up to and provide a background which facilitates understanding of evaluation data. This section is concerned with behavioral (performance) objectives of the program, description of participants, guiding student progress to the desired goals, instruments for measuring the variables involved in the objectives, gathering, reducing and analyzing data obtained from the instruments, and relating the results to the objectives of the project.

The last section of the report brings together the findings of the evaluation study and offers recommendations for further improvement of the program's implementation.

3.0 CONTEXTUAL DATA

3.1 Description of Locale.

Guam is "where America's day begins". Located west of the dateline, Guam is the first U.S. Territory to greet the dawn of each day. The island covers an area of 225 square miles and is about 3300 miles west of Honolulu, 1500 miles east of Manila and 1300 miles south of Tokyo. The island has a fascinating history. Its geographical beauty and tropical climate attract thousands of tourists. Its booming economy has made it a place of unlimited opportunity to many.

Early European explorers found Guam inhabited by Chamorros. Records describe Chamorros as a "handsome, robust people of light brown complexion with jet black hair, sometimes bleached yellow by the sun". Since Spain ruled Guam till 1898, Spanish culture became closely interwoven with that of the Chamorro people.

Now Guam is an unincorporated territory of the United States and its people are U.S. citizens. The present population numbering approximately 100,000 is a conglomerate of Chamorros, Filipinos, Japanese, Koreans, Chinese, Micronesians, Statesiders, and others.

The booming economy has triggered a proliferation of construction projects and brought new industries to the island. Increase in population and economy of the island has been accompanied by an increasing of environmental problems which signals a need for education in preservation of the environment.

3.2 Description of the Educational System.

In the Territory of Guam, the functions and jurisdictions of State and Local Educational Agencies are combined into a single Department of Education. There is only one public school system in this territory and that is the Department of Education, Government of Guam. Consequently, educational planning, developments, operation and evaluation are carried out by the Department of Education personnel.

In order to serve the educational needs of approximately 27,000 pupils from K-12 efficiently, the Department of Education has set up the structure of organization shown on the following chart.

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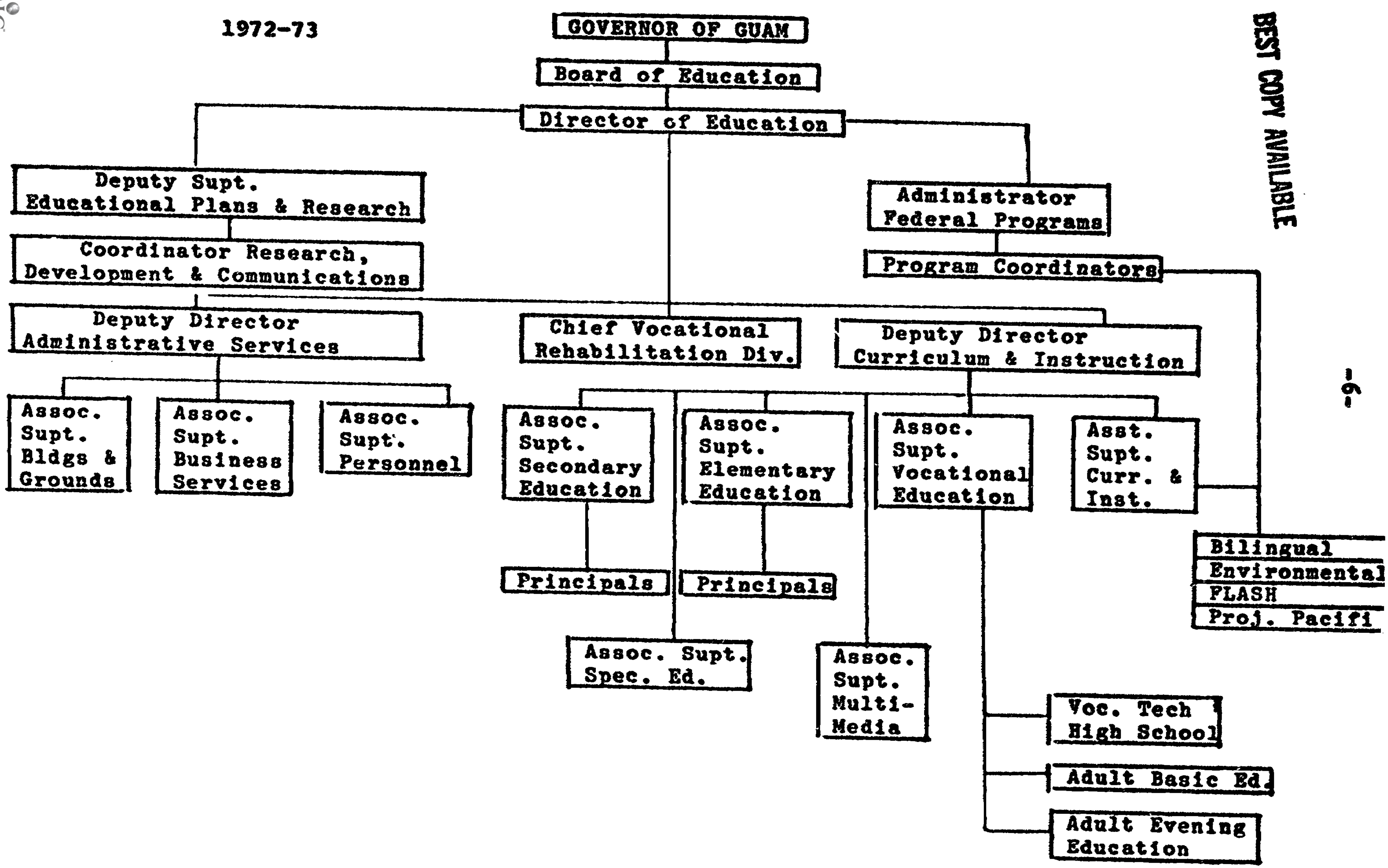
1972-73



Federal Programs Division is responsible for co-ordination and administration of federal programs relating to elementary and secondary education in the territory. All proposals from other divisions for federal funding are submitted to and reviewed by this division. The Environmental Education for Guam Schools Project (EEGSP) is funded through Title III of ESEA. The director of the EEGSP is the SPC (School Program Consultant) for Environmental Science in the Curriculum-Instruction Division of the Department of Education.

The Department of Education has a budget of $25,629,452 for its operation during 1972-73 academic year earmarked as shown,

Personnel	01 -	$18,311,593
Retirement	01 -	983,071
Hospital Ins.	01 -	97,405
Life Ins.	01 -	33,266
Local Travel	02 -	44,960
Off-island Travel	02 -	922,650
Contractual Services	03 -	1,042,351
Materials & Supplies	04 -	991,315
Equipment	05 -	1,039,758
Miscellaneous	09 -	33,266
	TOTAL -	$25,629,452

This amount represents the operational budget of the department. The per pupil expenditure for Government of Guam is $952. In addition nearly $7,000,000 from federal sources are expended on the education of students on the island, bringing the total per pupil amount to $1204.

3.3 Needs Assessment.

In recent years a sense of personal responsibility for Earth's deteriorating environment has received growing attention. Man's abuse of his little spaceship's resources -- green plants, air, water and minerals--has placed his own survival in jeopardy. His behavior must change if life is to continue, and the changing of behavior is the job of education -- at whatever level.

Guam, a moderately-sized tropical high island has its own environmental problems as well as those foisted upon it from the outside.

In 1963 The Department of Education itself published the Handbook For Elementary Teachers For A Conservation Education, but this received very limited use, if any. In 1969 three independent studies indicated a need for education relevant to Guam, two specifically meaning environmental education:

1. April - Needs Assessment Study of the Students

and Schools of Guam, conducted by the University of Guam, discussed "The need for development, improvement, evaluation and expansion of the current curricula, with special concern for its relevancy to Guam".

2. June - Management-oriented survey conducted by Mr. Gerald Perez, then Deputy Director, Department of Agriculture. Mr. Perez lists public education as the first priority in overcoming Guam's conservation ills, making the two following points:

   1. Integrated conservation education programs should be based primarily on Guam's problems and local needs. The understanding of local problems should then be used as a lever in developing an understanding of regional, national and world conservation problems.
   2. Conservation education should be integrated with all appropriate school subjects (science, social studies, etc.), and should emphasize the relationships of natural resources to the economic, social, and biological welfare of human beings.

3. November - Mr. Dan Saults, Fish and Wildlife official, U.S. Department of the Interior, Washington D.C. visited Guam in 1969 to assess

the island's conservation needs. His report to the Governor points out, "...Guam seems an ideal spot for environmental education; it is, in a sense, a little world, an ecosystem, and a living laboratory. The island offers small rivers and their estuaries--and a river basin study is almost a history of the natural world: rainfall, watershed, soil types and condition, botanical development, wildlife, aquatic life, vegetational and biological changes, and the effect of fresh water entering lagoons. There are mountains, many plants, marine studies... almost everything but tundra."

In July 1971 the proposal "Environmental Education for Guam Schools', written by James Branch, revised and resubmitted by Dave Hotaling, was approved by the Department of Education and implemented in August of that year to meet the needs validated in the above studies.

4.0 PROGRAM DATA

4.1 Scope of the Program.

The need for Environmental Education on Guam has been established, a proposal has been written, submitted, approved and the project was implemented in two locaations (Mongmong/Toto and Tamuning, both elementary schools) serving a total of 527 students.

4.2 Personnel.

In addition to the project director, Dave Hotaling, and the secretary, Lou San Nicolas, several other dedicated people offered their services to the program.

A task force, made up of people from several branches of the community assisted with ideas and time devoted to project productions. A list of these persons and their positions is herein presented:

1. Mrs. Pilar Lujan - Asst. Supt., Curriculum & Instruction
2. Mrs. Gloria Nelson - Assoc. Supt., Elementary
3. Mrs. Maria Roberto - Principal - Harry S. Truman Elementary School
4. Mr. Jim Branch - Administrative Head, Planning and Evaluation Unit, Dept. of Education
5. Capt. Shelburn Coleman - Bioenvironmental Engineer (SGPM) USAF Dispensary
6. Mr. Bob Cruz - Department of Commerce, Bureau of Parks and Recreation

7. Dr. Donald Davis - Department of Biosciences, University of Guam

8. Mr. Nick Drahos - Wildlife Biologist, Dept. of Agriculture

9. Dr. Robert Gourley - Field Staff Specialist, Northwest Regional Education Lab.

10. Mr. Dave Hotaling - Director, Environmental Curriculum Development Project

11. Mr. Eric Liljestrand - Teacher, Yigo Elementary

12. Cdr. Thomas Lonegan - Assist. Force Civil Engineer ComNavMar

13. Mr. Jeff Shafer - Biology Teacher, John F. Kennedy High School

14. Mr. Richard Sorby - Acting Director, Learning Resources Center

With the cooperation of the principals, Jose Apuron and Bernadita Terre, twenty-four teachers agreed to participate in the first pilot year of the project:

MONGMONG/TOTO	GRADE	TAMUNING
Linda Hasselbring Pat Olsen	1	Dorsee Bennett Shirley Scott
Susan Haftorson Eleanor Main	2	Emily Brauer Catherine Yoichi
Zelma Evans Mary Ravenscroft	3	Lu Biado Marjery Birkedal
Judy Chivers (1st. sem.) Estella Ramsey (2nd. sem.) Karyn Kaufman	4	Eunice Loots Jim Simmons
Chuck Mitchell Connie Pabalinas	5	Agnes Rinehart Linda Shidel
Judy Huney Ethel Willis	6	Paul Irvine Carl Mock

A successful mainland life-science program, Science Curriculum Improvement Study (SCIS), developed by the University of California at Berkeley was modified and tested by four teacher-naturalist-writers for Guam conditions. With the grades for which they wrote they are Jeff Shafer (1&5), Larry Behrens (2), Carol Wade (3), Carl Mock (4&6).

Susanne Wilkins, with assistance generously donated by personnel at Department of Agriculture, was the project technician, collecting and culturing thousands of organisms (such as algae, Hydrella, pond-snails, mosquito fish and guppies, pillbugs, Philippine ladybugs, water fleas (Daphnia), brine shrimp, fruit flies, grasshoppers, anoles, land-snails, praying mantises, and toads) for use in project classrooms.

Additional jobs in this federal project are those of Nature Trail Developers:

Mongmong/Toto - Eric Liljestrand
Tamuning - Carl Mock
Limestone Forest - Jean Strom
Reef Flat - Helen Larson & Carol Wade

Botany Advisors: Margie Falanruw, Phil Moore, Dick Randall

Artist: Alma van der Velde

Evaluator: Anthony Kallingal

Auditor: William Broadbent

4.3 Procedures - Introduction.

The goal of the EEGS project has been stated as follows: "To graduate citizens who are knowledgeable and conscientious about environmental problems of our island and of the world." In order to achieve this goal, the personnel listed in section 4.2 were involved in the implementation of the various project components. These components are briefly described below.

4.31 Program Components

4.311 - Curriculum Development

The Pacific islands share a number of characteristics which allow of interpreting the islands as a unit even though they are widely separated. Guam is naturally part of the Marianas chain and is ecologically similar in many respects, as could be expected.

Hawaii, insular, larger, with nearly ten times the population of Guam, and consequently more "developed" has already crossed many of the bridges Guam is approaching.

Both Hawaii and the Trust Territory are using the same basic elementary science program as we are piloting (the Science Curriculum Improvement Study). Additionally, the University of Hawaii's laboratory school is developing a junior high science sequence

(FAST - Foundational Approaches in Science Teaching) for tropical islands and tailored to follow up SCIS.

For these reasons the EEGSP has established a rapport with the Trust Territory and State of Hawaii Departments of Education as well as the science education division of and the laboratory school operated by the University of Hawaii.

The relationship with the Trust Territory has proven to be mutually beneficial in regard to curriculum development,and valuable to Guam, at least, with respect to Hawaii. Should Guam adopt part or all of the FAST program then Hawaii would be provided with another feedback source, making this relationship also one of mutual benefit.

Once the project got underway it was seen as desirable that a successful mainland program should be adapted to Guam conditions. Several were considered and the one chosen for adoption was that produced by the University of California at Berkeley, the Science Curriculum Improvement Study. Begun in 1960, this program had had years of experience, feedback, improvement and success by 1972 when our choice was made. Four teacher-naturalists began work in February to modify SCIS for Guam. The work was completed and copies xeroxed for the twenty-four teachers by August. (The only printed materials for students are manuals for the 4th, 5th, and 6th grades. It was decided to use the commercial ones rather than revise these, so copies were ordered from the Mainland.)

Several thousand small plants such as algae, Hydrella, duckweed, peas, beans and animals such as hydra, daphnia or water fleas, fish, grasshoppers, aphids, vinegar flies or fruit flies, praying mantises, toads are required for student activities. The great bulk of these were collected and/or cultured by Susanne Wilkins, project technician, with space, equipment and expertise donated by the Department of Agriculture.

Through announcements on the air, in the local daily newspaper and the newsletter of the Guam Science Teachers Association a nature picture contest was advertised. Over three hundred slides, plus a few drawings and paintings were submitted. These are being screened by project staff for pictorial quality and botanical/zoological applicability. Once final selection is made these will be printed in a series of booklets with accompanying narratives on the different natural communities on Guam (e.g. limestone forest, savannah, coral reef).

With assists from three advisors, four teacher-naturalists worked on nature trails, in the limestone forest, coral reef, and adjacent to the two project schools. These trails were open through the year, not only to project students but to all other teachers wishing to take classes on field trips to the areas. Lists of organisms likely to be found along the trails were developed and distributed to project teachers.

The sequence and concepts of SCIS: 1- Organisms, 2- Life Cycles, 3- Populations, 4- Environments, 5- Communities, 6- Ecosystems. The type of modification and adaptation of the SCIS material is exemplified in changes introduced in the Food Web game cards (see appendix, p.86). The modification of the curriculum* was completed and made available for classroom use by August 1972.

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*An overview of the curriculum as modified is presented in the Appendix.

4.312 - <u>Teacher Training</u>

A special course for elementary teachers on the environment of Guam was presented by the University of Guam during Spring Semester 1972. The objectives as stated in the approved project proposal were twofold: "To increase the knowledge of elementary teachers regarding the natural resources of Guam, and the conservation problems which exist here and throughout the world." "To increase the competence of the teachers in using the developed curriculum guides and supplementary materials."

Dr. Don Davis of the biosciences division was the chief instructor and was assisted by several others, experts in their fields, during the semester. The general procedure was to present background and lecture material on Tuesdays with follow-up field trips on Thursdays. Additionally, two full-day field trips were made on Saturdays. Although the course was originally titled a 'workshop' it was not one in the teachers' strict interpretation of the term. More than half the instruction time was devoted to field trips which the teachers could subsequently take with their students, but there was no class time devoted to preparing actual materials for use in elementary classrooms. As can be seen from the accompanying schedule (p. 20) a wide range of Guam's environmental facets and problems was covered.

Out of thirty-three teacher participants in the Teacher Training Program, twenty-four successfully completed the program. The distribution of grades is shown on p. 22.

Responses to the course were quite favorable, several of the teachers recommending that it be a requirement for all teachers as well as for teacher candidates at the University. (See accompanying summary, p. 24.) Dr. Davis, in his appraisal, states that the goals of the course have been achieved and is in general accord with the teachers' comments and recommendations. His critique is here included, p. 23.

And finally, at the suggestion and recommendation of Dr. Smith, Chairman of the Biosciences Division and the Project Director, the Guam Legislature on June 23, 1972 adopted Senator George Bamba's Resolution #531 requesting the University of Guam to offer the course on the island's environment on a permanent basis to our teachers (p. 26).

University of Guam Biology 490/590 1972

Jan.	25	Orientation	Davis**
	27	Basic Ecology	
Feb.	1	Basic Ecology	
	*3	George Washington Natural History Museum, Limestone Forest	
	8	Basic Ecology	
	*10	Coral Reef	
	15	Environmental Curricula and Projects	Burkman
	*17	Terrestrial and Aquatic Ecology	Branch
	22	Basic Ecology	
	29	Geology, Soils, and Water Resources of Guam	Randall
March	*2	Geology, Fire, Erosion, and Land Conservation	Randall
	7	Fisheries	Kami
	9	Starfish Explosion	Jones
	*11	Estuarine and Marine Resources	Jones & Kami
	14	Midterm Exam	
	16	Exam Review	
	21	Air Pollution	Levand
	23	Water Pollution	Capaldo, Levand
	*25	Air & Water Pollution	
	27-31	Easter Recess	
April	4	Biocides	
	6	Pest Control on Guam	
	11	Wildlife on Guam	Drahos
	13	Sanitary Land Fill and Schoolyard Ecology	Craft, Davis,DH
	18	Solid Waste	Craft
	20	Litter	
	22	Earth Day	
	25	People	
	27	Family Planning	Benson, Mackie
May	2	Future of Guam	Child, Sickler, Taitano, Unpingco
	4	Guam's Changing Environment	
	9	What Can You Do?	Farriss, L Hotaling, Kagle, Kami
	11	Where to Now?	
	16	Final Exam	

* Field Trip

**Davis unless noted otherwise

Following is the list of guest instructors with their affiliations at the time.

Dr. Joy Benson, Department of Public Health

Mr. Jim Branch, Science Consultant, Guam Dept. of Education

Dr. Ernest Burkman, Director Education Research Institute Florida State University, and General Consultant to Environmental Education for Guam Schools Project

Mr. Ernest Capaldo, Environmental Protection Agency, Dept. of Public Health

Dr. George Child, Systems Ecologist, University of Guam

Mr. Robert Craft, USN Public Works

Mr. Nick Drahos, Wildlife Biologist, Department of Agriculture

Ms. Carol Farriss, Pacific Daily News

Ms. L Hotaling, Program Director, Insular Arts Council of Guam

Dr. Robert Jones, Professor, University of Guam

Mr. Joe Kagle, Chairman, Department of Fine Arts, University of Guam

Mr. Harry Kami, Fisheries Biologist, Department of Agriculture

Dr. Oscar Levand, Environmental Protection Agency, Dept. of Public Health

Mr. Richard Mackie, Department of Public Health

Mr. Richard Randall, Pacific Corals Specialist, University of Guam

Mr. Harry Sickler, Territorial Planning Commission

Mr. Richard Taitano, President, Guam Environment Council

Mr. Norbert Unpingco, Manager, Guam Visitors Bureau

Distribution of Grades Based On Examinations and Reports

A	-	3
B	-	9
C	-	11
D	-	1
F	-	5
Withdrawals	-	4

DEPARTMENT OF BIOLOGY
UNIVERSITY OF GUAM
P. O. Box EK Agana, Territory of Guam, U. S. A. 96910

27 April 1972

To: Director, Environmental Curriculum Project
From: Dr. Don Davis, Associate Professor and BI490W/590 instructor
Subject: Critique of BI 490W/590, Spring, 1972

As the semester draws this first offering of Environmental Workshop for Elementary Teachers to a close, I would say that the original needs and ojectives for the course have been adequately met.

The basics of ecology have been presented and amply exemplified by local natural systems. All primary environmental crisis areas have been covered from both global and local viewpoints. Extant and potential island problems have been examined in the classroom and in the field. The remaining portion of the course will deal with long range solution of the environmental crisis.

The field experiences have proved of great value. There could be some combining of some of the trips in future runs of the course to cut down on expenses.

Outside expertise, when well presented, was rewarding and informative for the teachers, but some decrease in the number of those resource people is recommended for future offerings of the course.

Many of the teachers have complained of the lack of training within the course in the use of specific materials which will be used in the Pilot Project next academic year. Such training was impossible this semester since the materials (and curriculum) to be utilized next fall have not as yet been developed. Future offerings of the course should contain contact with as much of the specific Pilot material as possible as it becomes available.

It is recommended that this course not be offered again for graduate credit (BI 590) but only at the BI 490W level. Considerable difficulty has been experienced in directing the research of those taking the 590 option this semester. Most were unprepared to attempt graduate level research, and counselling proved difficult to arrange owing to the full teaching loads of the teachers involved.

In summary I recommend the continued offering of BI 490W at the undergraduate level only, with a maximizing of the field trip experiences and an inclusion of specific Pilot Project materials as they become available.

Respectfully submitted,

D M Davis

Summary - Critiques Of Course BI 490/590

- The course should have been designed as a workshop which would help teachers present environmentl material to elementary students rather than a course in introductory biology

- Field trips were effective.

- Learning the names of many more Guam plants and animals would have been helpful. (During field trips more than 60 organisms were identified.)

- Final exams not helpful and should be done away with.

- Course should be required of all teachers on Guam.

- Course should be a degree requirement of the University of Guam.

The majority of the critiques expressed approval of teaching Guam's students about their environment.

Some random suggestions for improving the course.

- Have groups of teachers make up teaching projects and exchange the results in lieu of examinations.

- Base grades on materials produced by individual course members.

- Base grades on specified amounts of work for the course and allow the individual to choose which grade he wants to work for.

- Present a concrete example, via demonstration, of an elementary teacher presenting environmental material to her students.

- Divide course into two semesters: 1st semester teach concepts; 2nd semester teach concrete examples (have lab experiments, etc), and employ them in workshop concept.

- Schedule the class at some more convenient time and consult the elementary school calendar before setting up class and field trip times.

- Conduct field trips for smaller groups.

- Announce field trips in advance and pass out field trip itineraries in advance.

Introduced 4-18-72

Adopted 6-23-72

ELEVENTH GUAM LEGISLATURE
1972 (SECOND) Regular Session

Resolution No. 531

Introduced by ______________
G.M. Bamba

Relative to requesting the University of Guam to establish permanent in-service training program for elementary teachers in environmental problems on Guam.

BE IT RESOLVED BY THE LEGISLATURE OF THE TERRITORY OF GUAM:

WHEREAS, the limitations of the natural environment to adjust to pressures exerted by man has dictated that the people of Guam become increasingly aware of their surrounding environment and the ecological balances of nature; and

WHEREAS, the Department of Education of the government of Guam is the recipient of an E.S.E.A. Title III Grant which is intended to develop a curriculum in the public schools in environmental education; and

WHEREAS, a portion of the moneys allocated pursuant to E.S.E.A. Title III Grant is allocated to the in-service training of elementary teachers in environmental problems on Guam; and

WHEREAS, the University of Guam is presently conducting a pilot program of such in-service training and possessed the capability of and interest to provide such a training program on a permanent basis; now therefore be it

RESOLVED, that the Eleventh Guam Legislature does hereby respectfully request the Board of Regents of the University of Guam to establish a permanent in-service training program for elementary teachers in environmental problems on Guam; and be it further

RESOLVED, that the Speaker certify to and the Legislative Secretary attest the adoption hereof and that copies of the same be thereafter transmitted to the Chairman of the Board of Regents of the University of Guam, to the President of the University of Guam, to the Director of Education, and to the Governor of Guam.

4.313 - Instructional Component

All the instructional materials developed were placed in the hands of the project teachers in Tamuning and Mongmong/Toto for use in the instruction of children.

The approach to teaching placed emphasis on:

1. Doing activities.
2. Having students observe, interpret, describe, compare, classify, measure and experiment.
3. Having the teacher provide materials and guidance but not lecture.
4. Giving the students opportunities to make discoveries for themselves.
5. Encouraging students to talk about their experiences in their environment.
6. Having the teacher provide the students with time for inquiry, experimentation and discussion.

Basically the instruction in the project attempted to capitalize on young people's innate appreciation for and curiosity about the plants and animals around them. Small organisms were used to demonstrate such biological concepts as life cycles, population increases and decreases (the latter all too frequent and unexpected according to some of the teachers!), responses to environmental factors such as light-dark and cold-hot and wet-dry, organisms' interrelationships in food chains, food webs and in ecosystems. Aquaria and terraria were supplied to small teams of students and were furnished with organisms obtained mostly from Department of Agriculture. During field trips to places such as Agana Springs some teams made small collections to be placed in their containers. The students raised seedlings and animals and in so doing developed a sense of competition in these activities.

Both teachers and students enjoyed working with the instructional materials developed in the project. "Really great - children like it and I like it" were some of the comments made by the project teachers.

4.314 - Community Involvment

From the inception of the project year until its completion, attempts were made to involve the community wherever possible and to keep the community informed of the undertakings and developments in the project.

An Environmental Task Force was set up in September 1971 and consisted of members from various segments of the island community including the military. Their principal task may be described as follows: "The job of the Task Force will be to generate several different approaches to problems and then decide on the best strategies'. Once the planning stage is over, the Task Force will help evaluate the outcome.

As the program develops, members will be encouraged to pursue their own interests and concerns in developing materials to be placed in the hands of teachers and in-service programs". The committee held a total of nine meetings from September 1971 to June 1973. The critical comments of the Task Force were beneficial in steering the program and in general the Task Force provided encouragement and moral support to the project staff in their activities.

Supportive groups like Department of Agriculture, Department of Public Health, Learning Resources Center, Public Broadcasting Station KGTF and the Pacific Daily News were actively involved in the development of instructional and/or promotional materials for the project.

The Guam Legislature manifested support for the project by adopting a resolution requesting that the University offer the course on Environment of Guam on a permanent basis to island teachers. Guam Science Teachers Association and the Marine Laboratory Staff of the University of Guam have rendered invaluable service to the project in the area of identifying and describing the island flora and fauna. The Navy donated two helicopter flights for photographing the island's natural communities.

The list of community involvement could go on and on. Suffice it to say that the project enjoyed inordinate support, encouragement and active particpation from the community, including Hawaii and the Trust Territory.

4.4 Budget (expenditure).

Following is the budget breakdown of EEGSP 1972-73.

Personnel	01 -	$23,200
Travel	02 -	2,000
Contractual Services	03 -	20,550
Materials & Supplies	04 -	1,000
Equipment	05 -	1,700
Miscellaneous	09 -	2,000
TOTAL	-	$50,450

EVALUATION DATA

5.1 Hierarchy of Objectives.

The ultimate goal of the Environmental Education Project for the Schools of Guam may be described as follows:

To graduate citizens who are knowledgeable and conscientious about the environmental problems of Guam and of the world.

The variables that go to make a person knowledgeable and conscientious about environmental problems fall into three overlapping and interrelated domains. The domains are cognitive, affective and skill domains. The following set of intermediate student-centered objectives are derived from the ultimate goal and relate to the threefold-domain-variables.

Cognitive Domain:

Participants acquire an understanding of natural resources of environment, of basic ecological laws, of man's dependence on these laws and of the consequences of violating these laws.

Affective Domain:

Participants develop an active interest and responsibility in conservation of natural resources.

Skill Domain:

Particpants develop skills necessary for preservation of natural resources.

These intermediate objectives are stated in general, not performance-based terms. However, these statements of objectives do provide a direction to the attempt to state the objectives in specific behavioral terms. These specific performance-based objectives are stated for each grade level.

In the cognitive domain the objectives are stated in terms of percentages reaching a criterion level of performance and in terms of higher performance when compared to the control group. In the affective and skill domains, the objectives are stated only in terms of percentages reaching the criterion level.

The derivation of behavioral objectives in the affective domain was based on the premise that knowledge of environmental factors and man's dependence on them would necessarily result in the development of certain affective traits which characterize a person interested in and responsible for preservation of environment. Further it was hypothesized that field trips, individualized projects in accord with individual tastes of students, and various kinds of scientific experiments would contribute to the development of the desired affective traits.

All the factors that characterize an interested and responsible person were not measured for the purpose of this year's summative evaluation. The factors chosen for the year were curiosity, inventiveness, critical thinking and persistence. It is planned that an affective instrument which includes a larger number of factors be developed for next year's evaluation.

Grade 1

Cognitive.

75% of the students will demonstrate criterion levels of performance on Environmental Test I designed to measure knowledge of organisms: naming plants and animals, identifying requirements for life, describing habitat and foodweb.

Experimental students in the first grade will score significantly higher on ET I than the control first grades.

Affective.

75% of the first graders will score above average ratings by teachers on curiosity, inventiveness, critical thinking and persistence

Skills.

75% of the first graders will be able to correctly observe phenomena that occur in aquaria: results of birth and/or hatching, growth, death, and decay.

Grade 2

Cognitive.

75% of the second graders will demonstrate criterion levels of performance on Environment Test II designed to measure knowledge of the stages in life histories of certain plants and animals and the differences between living and non-living.

Experimental students in the second grade will score significantly higher on ET II than the control second graders.

Affective.

75% of the second graders will score above average ratings by teachers on curiosity, inventiveness, critical thinking and persistence.

Skills.

75% of the second graders will be able to tend plants from seed to maturity and selected small animals from egg to adult and to correctly observe differences in stages of life cycles of the selected plants and animals.

Grade 3

Cognitive.

75% of the third graders will demonstrate criterion levels of performance on Environment Test III designed to measure knowledge of populations of organisms, including their growth curve of increase, levelling off and decline.

Experimental third graders will score significantly higher on ET III than the control third graders.

Affective.

75% of the third graders will score above average ratings by teachers on curiosity, inventiveness, critical thinking and persistence.

Skills.

75% of the third graders will be able to set up aquaria and terraria and maintain them successfully while correctly observing the food chains therein.

Grade 4

Cognitive.

75% of the fourth graders will demonstrate criterion levels of performance on Environment Test IV designed to measure knowledge of environmental factors, the effect on organisms of changes in light, water, and temperature, and the concepts of range and optimum range for environmental factors.

Experimental fourth graders will score significantly higher on ET IV than the control fourth graders.

Affective.

75% of the fourth graders will score above average ratings by teachers on curiosity, inventiveness, critical thinking and persistence.

Skills.

75% of the fourth graders will be able to design experiments which determine responses of organisms to changes in environmental factors.

Grade 5

Cognitive.

75% of the fifth graders will demonstrate criterion levels of performance on Environment Test V designed to measure knowledge of communities of organisms and the food relationships (energy transfers) which occur within.

Experimental fifth graders will score significantly higher on ET V than the control fifth graders.

Affective.

75% of the fifth graders will score above average ratings by teachers on curiosity, inventiveness, critical thinking and persistence.

Skills.

75% of the fifth graders will be able to diagram a food pyramid from observations of selected communities and identify the producers, consumers and decomposers involved.

Grade 6

Cognitive.

75% of the sixth graders will demonstrate criterion levels of performance on Environment Test VI designed to measure knowledge of ecosystems and the goings-on within them, including exchanges of matter and energy and roles played by oxygen, carbon dioxide and water in maintaining life.

Experimental sixth graders will score significantly higher on ET VI than the control sixth graders.

Affective.

75% of the sixth graders will score above average ratings by teachers on curiosity, inventiveness, critical thinking and persistence.

Skills.

75% of the sixth graders will be able to set up a composite aquarium-terrarium and correctly observe its components including those of the water cycle in action.

5.2 Selection of Schools.

In order to achieve the objectives stated in the previous section, two experimental schools were selected for trial of the modified Science Curriculum Improvement Study (SCIS) materials. The method of selecting the two schools is described below.

During the Spring of 1972, the project arranged with the University of Guam the offering of a course designed to train elementary teachers in environmental education. For details about the course refer to section 4.312 p. 18.

The project paid tuition and textbook expenses to twenty-nine elementary teachers who volunteered to take the course. Four schools were strongly represented in this group of twenty-nine teachers -- Mongmong/Toto, Tamuning, Ordot/Chalan Pago, and Harry Truman.

All the teachers in the class were asked to state which one of the four schools they would choose to teach in during 1972-73. Mongmong/Toto and Tamuning received pluralities and therefore these two were chosen as experimental schools.

Mongmong/Toto has a total student enrollment of 733* distributed in grades 1 to 6. Three-fourths are Guamanian. Tamuning has a total student enrollment of 1,067* distributed in grades 1 to 6. Tamuning school students (including kindergarten) make up a fairly cosmopolitan community, as follows: Guamanian (587), Filipinos (353), Micronesian (72), Oriental (59), Caucasian (175), Negro (1), others (77), total (1,327).

The project director selected Price and Harmon Loop Elementary Schools for control on the basis of similarity of ethnic composition, age level and achievement level. The data provided in Tables A and B indicate the extent to which the experimental and control schools are similar with respect to sex distribution and ethnic composition.

* As of February 28, 1973.

Table A.

Ethnic Composition of Students by Schools K-6

	Mongmong Toto	%	Tamuning	%	Harmon Loop	%	Price	%
Guamanian	618	74.8	587	44.2	329	37.7	496	68.8
Filipino	113	13.7	356	26.8	390	44.7	88	12.2
Micronesian	22	02.7	72	05.4	44	5.0	34	4.7
Oriental	14	01.7	59	4.4	13	1.5	6	0.8
Caucasian	53	06.4	175	13.2	95	10.9	68	9.5
Negro	3	00.4	1	0.1	2	0.2	3	0.4
Others	3	00.4	77	5.8	--	--	26	3.6
TOTAL	826	100.0	1,327	100.0	873	100.0	721	100.0

5.3 Description of Participants.

This section provides information on sex, aptitude and pre-test achievement data for each grade level.

Out of 527 participants in the pilot schools 282 were males and 245 were females. In the control schools the total number of male students was 265 and the females numbered 241. The sex distribution for each grade is shown in Table B.

Table B.

Distributions of Students by Sex and Grade

		Experimental	%	Control	%
Grade 1	Female	42	48.3	36	52.9
	Male	45	51.7	32	47.1
	Total	87		68	
Grade 2	Female	45	47.9	45	48.9
	Male	49	52.1	47	51.1
	Total	94		92	
Grade 3	Female	45	48.4	50	50.0
	Male	48	51.6	50	50.0
	Total	93		100	
Grade 4	Female	37	43.5	44	42.7
	Male	48	56.5	59	57.3
	Total	85		103	
Grade 5	Female	33	40.7	45	46.9
	Male	48	59.3	51	53.1
	Total	81		96	
Grade 6	Female	43	49.4	21	44.7
	Male	44	50.6	26	55.3
	Total	87		47	

<u>Pre-Test</u>: Baseline achievement data were gathered on the experimental and control students utilizing locally developed instruments for each of the six grade levels.

The tests were constructed by the respective teachers in the experimental and control schools. All teachers were given the Teachers' Guides and asked to familiarize themselves with the objectives of SCIS curriculum for each grade and content for each grade. The teachers were then requested to construct as many items as possible. From the resulting pool of test items the project director and teachers made a selection of best items which were formulated into a pre-test for each grade level.

The items finally chosen for pre-test could not be described as 100% satisfactory in terms of psychometric criteria. Time pressures did not allow for revisions designed to remove ambiguities and other factors of invalidity and unreliability. No empirical investigation of item qualities on the validity and the reliability of the tests was undertaken. In spite of these drawbacks, the tests do have a modicum of content validity in that the items were constructed on the basis of objectives and curriculum content. The results were used for comparison of the experimental sample with the control sample relative to the initial achievement levels in the cognitive area.

The pre-tests were administered in September/ October 1972. The first and second grade tests had to be administered with the teachers reading out each item to the students. Four of the thirteen items on first grade tests required the teacher to read these questions to students individually and then mark down their answers. This task proved to be too time-consuming and the administration of the test was not carried out in a uniform fashion. As a result, scoring of the first grade test was not carried out. No problem was encountered in the administration of tests in grades 2-6.

The mean score for each class in the experimental and control schools was computed and the results are reported in Table C. In addition, the overall mean score for all classes at a particular grade level was computed for experimental and control contexts. (Refer to Table D.)

Table C.

Mean Score Distribution by Schools and Grades

PRE-TEST

	Experimental				Control			
Grades	MMT	MMT	TAM.	TAM.	HARMON LOOP	HARMON LOOP	PRICE	PRICE
1	No score (refer to narrative on page 44).							
2	5.7	5.9	5.1	3.8	7.0	4.4	8.0	7.8
3	4.3	3.4	3.0	3.5	4.8	3.5	3.6	3.9
4	-	-	3.5	3.7	3.7	5.5	3.6	4.4
5	7.0	6.0	5.1	7.9	8.9	6.6	7.3	7.1
6	1.7	1.5	1.6	2.0	1.4	-	2.2	1.5

Table D.

Mean Score Distribution on Pre-Test

	Experimental	Control
Grades		
1	No score (refer to narrative on p. 44).	
2	5.0	6.8
3	3.6	3.9
4	3.6	4.3
5	6.6	6.9
6	1.7	1.7

In general the control groups performed better on the pre-test than the experimental students. Based on these data it can be safely assumed that differential gains, if any, achieved by the experimental students should be attributed to the program.

No baseline data relative to skills and attitudes were gathered. An assumption was made that the two groups are similar in the levels of skill and attitude development in the area of environmental conservation.

5.4 Monitoring Student Progress.

Monitoring student progress consists in a systematic appraisal of student responses to their experiences in the various units of the curriculum undertaken by teachers periodically and continuously during the year for feedback and possible modification. This design seeks to assess to what extent this monitoring has been carried out.

Unfortunately no scheme was developed that would assist the teacher in monitoring student progress toward the desired goals. Teachers were left to their own devices and traditional techniques of classroom observation, periodic assignments and quizzes.

Teachers periodically report back to the project director concerning the activities in the classroom. A format for this type of implementation feedback was provided by the project director. See appendix III for sample (p.87).

5.5 Instrumentation.

Pre-tests: Development and administration of pre-tests were referred to in an earlier section (5.3). The pre-tests were developed by the project staff, mostly teachers in September of 1972 and administered to the experimental and control students from grades one to six. The data served as one of several factors in determining the comparability of the control and experimental groups. The data revealed that the experimental students were in general lower in their performance than the control.

Post-tests: The instruments for measuring dependent variables in cognitive domain were developed by the project teachers for each grade level. These six tests were developed and they are called Environment Test I thru VI. These tests were reviewed item by item for content coverage and possible factors of unreliablility by the evaluator and the project director. The revised tests for all grades were printed and made available for use in the experimental and control classes.

The tests represent a medley of item types. A large portion of the items in the tests was of multiple choice nature and the students were asked to choose the best answer for each item.

However, there were also completion items and matching items.

Because of meticulous adherence to the psychometric principles of good item construction, and test revision, the instruments are considered to possess satisfactory levels of validity and reliability in spite of the fact that no empirical investigation was undertaken to verify the same.

These tests were administered to experimental and control classes by the middle of April, 1973. The data are summarized and presented in the next section (5.6) of this report.

The Environmental Interest and Responsibility Rating Scale (EIRRS).

In addition to the cognitive outcomes, the project attempted to instill positive attitudes toward the environment and study of biological sciences. The EIRRS was developed for assessment of these attitudes. The development of this rating scale reflected the philosophy of the Science Curriculum Improvement Study.

The EIRRS requires classroom teacher to rate each of the students on thirteen factors using a scale of 1 to 5 -- 1 representing "poor" and 5 representing "excellent" and other numbers representing intermediary positions on the continuum. The thirteen factors are grouped under four major headings: curiosity, inventiveness, critical thinking and persistence.

The development of an Observation Schedule for assessment of skills did not materialize and therefore no data were gathered on the objectives in the skills domain.

5.6 Presenting Data.

This section presents data on outcomes of the intervention variable. Pre-test data are not included here because (1) they were already reported in an earlier section, (pp. 45 & 46), (2) the data are not used in the analysis of results. The reason why it is not used in the analysis was that the control and experimental did not differ significantly on pre-test data.

To assess the cognitive outcomes in all grades, tests locally developed and validated were employed both in the experimental and control classes. The affective outcomes were measured by means of a rating scale designed to assess various factors of scientific attitude. The factor breakdown was based on the ideas of the curriculum developers. Student satisfaction was assessed by the teachers post factum.

Tables E and F present achievement scores on Environment Tests Levels I to VI. Each level corresponds to a grade level. Three measures of central tendency (mean, median and mode) and two measures of dispersion (range and standard deviation) for each of the classes in the two locations are entered on the tables.

Mean and standard deviation for all classes combined at each grade level are presented in Table G.

Table E.

Central Tendency and Dispersion Measures Achievement of Scores of Students in the Experimental Schools

	MONGMONG/TOTO		TAMUNING	
	Class 1	Class 2	Class 1	Class 2
GRADE 1				
Mean	12.541	21.727	17.086	20.777
Median	12 1/2	22 1/2	18	21
Mode	16	23	18	23
Range	15	10	15	8
Standard Deviation	4.01	2.955	2.98	2.46
GRADE 2				
Mean	20.296	16.961	19.631	21.869
Median	21	18 1/2	21	23
Mode	19	n/a (13,17,19,21)	n/a (16,18,21,22)	n/a (21,23,25)
Range	15	19	11	13
Standard Deviation	3.9	5.33	3.41	3.21
GRADE 3				
Mean	16.777	22.695	17.142	23.045
Median	18	23	18	22
Mode	n/a (15,18)	23	n/a (17,18,19)	n/a (20,22,24)
Range	21	18	14	16
Standard Deviation	5.33	4.27	4.26	4.50

Cont'd
Table E.

	MONGMONG/TOTO			TAMUNING	
	Class 1		Class 2	Class 1	Class 2
GRADE 4					
Mean		12.260		16.307	15.000
Median		11 1/2		16	15
Mode		9		n/a (12,17,19)	10
Range		12		13	11
Standard Deviation		1.59		4.11	3.26
GRADE 5					
Mean	15.310		24.172	23.142	
Median	16		26	24	
Mode	16		27	29	
Range	11		20	12	
Standard Deviation	2.94		5.75	4.08	
GRADE 6					
Mean		19.525		22.105	19.100
Median		18		24	19
Mode		18		24	n/a (19,21)
Range		24		13	14
Standard Deviation		6.26		3.46	3.85

Table F.

Central Tendency and Dispersion Measures Achievement of Scores of Students in the Control Schools

	HARMON LOOP Class 1	HARMON LOOP Class 2	PRICE Class 1	PRICE Class 2
GRADE 1				
Mean	12.560		18.333	11.909
Median	13		19	12
Mode	12		21	12
Range	7		9	8
Standard Deviation	2.22		2.63	2.14
GRADE 2				
Mean	15.526	13.428	17.526	14.923
Median	16	13	18	15
Mode	n/a (15,17,18)	10	19	n/a (13,14,15,17)
Range	10	13	11	7
Standard Deviation	2.50	3.34	3.36	1.89
GRADE 3				
Mean	12.000	12.520	12.541	23.720
Median	15	13	13	24
Mode	n/a (14,15)	13	13	24
Range	23	15	10	11
Standard Deviation	5.23	3.75	2.24	2.56

Cont'd
Table F.

	HARMON LOOP		PRICE	
	Class 1	Class 2	Class 1	Class 2
GRADE 4				
Mean	13.750	13.766	13.115	12.037
Median	13	13 1/2	13	13
Mode	13	16	14	14
Range	15	12	13	11
Standard Deviation	3.35	3.19	3.22	2.91
GRADE 5				
Mean	17.375	13.928	15.150	15.500
Median	17	13	15 1/2	15
Mode	17	13	16	15
Range	14	11	10	8
Standard Deviation	3.83	2.94	2.87	2.02
GRADE 6				
Mean			16.444	21.500
Median			17	22
Mode			21	13
Range			17	22
Standard Deviation			4.89	7.04

Table G.

Mean and Standard Deviation on Post Tests by Grade Level

GRADE	EXPERIMENTAL	CONTROL
1	$\bar{X}$ = 17.78 S = 5.21 N = 87	$\bar{X}$ = 14.13 S = 3.66 N = 68
2	$\bar{X}$ = 19.63 S = 4.50 N = 95	$\bar{X}$ = 15.13 S = 3.26 N = 92
3	$\bar{X}$ = 19.81 S = 5.56 N = 93	$\bar{X}$ = 15.19 S = 6.22 N = 100
4	$\bar{X}$ = 13.61 S = 3.09 N = 86	$\bar{X}$ = 13.14 S = 3.20 N = 103
5	$\bar{X}$ = 20.65 S = 6.11 N = 79	$\bar{X}$ = 15.44 S = 3.26 N = 96
6	$\bar{X}$ = 20.04 S = 5.3 N = 79	$\bar{X}$ = 18.60 S = 6.42 N = 47

Explanation of Tables.

The data indicate that the program objectives in the cognitive domain have been accomplished. It remains to be investigated whether these accomplishments are a function of the particular nature of the sample studied or they are generalizable to a larger population. This is an inferential question which is taken up in the next section.

5.7 Analyzing Data.

This section presents inferential analyses of baseline data and program outcome data. The reader will note that statistical procedures of inference provide tools for estimating the state of affairs in a larger population from knowledge of sample. The environmental project was implemented on a sample of 527-odd students. Statistical inference relates to the question: what would be the outcome of the project were it to be implemented on a larger population? In other words, statistical inference attempts to determine whether the results that ocurred in the sample are a function of the particular nature of the sample studied or whether they are generalizable.

The inferential analyses on the baseline data are meant to determine the comparability of the experimental and control groups. These analyses seek to show that experimental samples and control samples belong to the same population and therefore the distribution characteristics of the samples would not depart from the population distribution characteristics to a greater extent than would be tolerated by sampling error.

Inferential analyses of baseline data indicate that the control and experimental groups are similar in terms of their cognitive achievement relative to ecological sciences. Please note that the control samples have slightly higher means than the experimental groups and this would indicate that the improvements of experimental groups could well be attributed to the project at least as far as the sample is concerned.

Similar hypotheses testing procedures were undertaken in the analyses of cognitive outcomes of the project.

The purpose of inferential analyses on achievement data is to determine the extent of generalizability of the sample findings. Differences in the means of the experimental and control groups constitute the sample findings. Any differential gain on the part of the experimental students is attributed to the program. Now the question is whether this gain is generalizable to the general student population in Guam. This question was answered using hypotheses-testing technique, specifically independent two-sample t-test.

The test statistic for t-test differs for the case I where the population of interest are homogeneous with respect to variance and for the case II where there is no homogeneity of variance.

Test statistic for case I.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(N_1-1)S_1^2+(N_2-1)S_2^2}{N_1+N_2-2}\left(\frac{1}{N_1}+\frac{1}{N_2}\right)}}$$

with d.f.= $N_1 + N_2 - 2$.

Test statistic for case II.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^{2}}{N_1} + \frac{S_2^{2}}{N_2}}}$$

Here the required t-value for a given level of significance is determined by averaging t-values for (a) degrees of freedom equal to N_1-1 and (b) N_2-1 (James Popham, p. 168).

Since the t-statistic used depended on the assumption of homogeneity of variance, a simple statistical test, the F ratio, was employed to determine whether there is any reason to suspect lack of homogeneity. The results of the F-test were used for choosing appropriate t-statistic (see Table H).

Table H.

Table of F Ratios for Each Grade Level

Grade	F-value	Decision Taken
1	2.0312	Reject Assumption
2	1.9070	Reject Assumption
3	1.2573	Accept Assumption
4	1.0725	Accept Assumption
5	3.5114	Reject Assumption
6	1.4708	Accept Assumption

As is clear from the table, there was no reason to suspect lack of homogeneity of variances in grades 3, 4 and 6 and therefore the t-statistic for case I was used with these grades. Assumption of homogeneity was not held in the case of grades 1, 2 and 5 and the t-statistic for case II was employed with these grades.

The results of the appropriate t-tests are given in Table I.

Table I.

Table of Computed and Required (at Alpha=.05) T-Values for each Grade Level

Grade	Computed T-Value	Required T-Value
1	2.01	1.67
2	7.89	1.67
3	7.22	1.66
4	1.02	1.66
5	8.94	1.67
6	1.37	1.66

As can be seen from the table of t-values, the differences in favor of experimental classes were significant at all grade levels except fourth grade and sixth grade. This means that the differential gains in scores that the experimental students in grade 1, 2, 3, and 5 made in relation to control students are generalizable to the larger student population on Guam. The differential gains of the experimental fourth graders and sixth graders could have been due to chance fluctuation and hence not generalizable. However, the reader should note that the control students in fourth and sixth grades were better off in their knowledge about environment when the program started. At the end of the program, the experimental groups did surpass the control students, not to a degree of statistical significance. The t-test is based on the improvement that the experimental groups made after they caught up with the control students. It might well be that the total improvement in both grades was significant.

The cognitive objectives were stated also in terms of percentages that were expected of those who would achieve a predetermined level of achievement on post-tests. The method of determining this criterion level has been described elsewhere. Table J provides criterion levels, frequencies and percentages of those reaching the criterion levels.

Table J.

Frequencies and Percentages of Those Reaching Criterion Levels in All Grades

Grade	Criterion Level	Frequency	Percentage
1	15	63	74.2
2	18	68	71.6
3	21	49	52.7
4	14	44	51.2
5	18	50	63.3
6	20	36	45.6

In grades 1, 2 and 5, the obtained percentages were fairly close to the expected percentage which was seventy-five percent. In grades 3, 4 and 6, the obtained percentages fell slightly short of the expected percentages.

Attitudinal objectives were assessed by means of a rating scale on Curiosity, Inventiveness, Critical Thinking and Persistence. The scale ranged from 1 to 5. Rating was based on certain specified behaviors that a student exhibited. The scale values of 1 to 5 indicated that the student showed a specified behavior 'never', 'seldom', 'an average amount', 'more than average' and 'to an outstanding degree' respectively.

Curiosity was defined in terms of four behavioral patterns. --- a. using several senses to explore organisms; b. asking questions; c. observing organisms on first entering class; d. showing interest in experiment outcomes.

Inventiveness was defined in terms of three behavioral patterns. --- a. using equipment in new ways; b. suggesting new experiments; c. describing novel conclusions from observations.

Critical Thinking was defined in terms of the following three. --- a. using evidence to justify conclusions; b. pointing out weaknesses in others' reports; c. changing ideas in response to evidence.

Finally the following behaviors were considered indicative of the trait of Persistence:

a. continuing investigations after the novelty has worn off; b. repeating an experiment to get "better" results; c. completing an activity even though classmates finished earlier.

For each student the ratings of the behaviors in a particular area say curiosity were averaged and rounded to obtain a single rating for the area. Frequencies and percentages of these area ratings are shown in Tables K to P.

Table K.

Fréquencies of Ratings Given to First Graders on

1) Curiosity, 2) Inventiveness, 3) Critical Thinking, and 4) Persistence

Ratings	Curiosity		Inventiveness		Critical Thinking		Persistence	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	11	12.64	10	11.49	13	16.94	12	13.79
2	14	16.10	13	14.95	17	19.54	16	18.39
3	29	33.33	30	34.48	27	31.03	31	35.63
4	25	28.73	24	27.59	23	26.44	22	25.29
5	8	9.20	10	11.49	7	8.05	6	6.90
TOTAL	87	100	87	100	87	100	87	100

Table L.

Frequencies of Ratings Given to Second Graders on
1) Curiosity, 2) Inventiveness, 3) Critical Thinking, and 4) Persistence

Ratings	Curiosity		Inventiveness		Critical Thinking		Persistence	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	12	12.63	6	6.32	11	11.58	6	6.32
2	15	15.79	24	25.26	19	20.00	19	20.00
3	33	34.74	38	40.00	33	34.74	38	40.00
4	28	29.47	20	21.05	29	30.52	27	28.42
5	7	7.37	7	7.37	3	3.16	5	5.26
TOTAL	95	100	95	100	95	100	95	100

Table M.

Frequencies of Ratings Given to Third Graders on

1) Curiosity, 2) Inventiveness, 3) Critical Thinking, and 4) Persistence

	Curiosity		Inventiveness		Critical Thinking		Persistence	
Ratings	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	10	10.75	12	12.90	8	8.61	10	10.75
2	18	19.35	20	21.50	29	31.18	21	22.58
3	25	26.88	22	23.66	25	26.88	20	21.50
4	24	25.81	26	27.96	21	22.58	27	29.04
5	16	17.21	13	13.98	10	10.75	15	16.13
TOTAL	93	100	93	100	93	100	93	100

Table N.

Frequencies of Ratings Given to Fourth Graders on
1) Curiosity, 2) Inventiveness, 3) Critical Thinking, and 4) Persistence

Ratings	Curiosity		Inventiveness		Critical Thinking		Persistence	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	5	5.81	9	10.46	6	6.98	7	8.14
2	23	26.74	17	19.77	25	29.07	28	32.56
3	25	29.07	26	30.23	30	34.88	16	18.60
4	22	25.58	24	27.91	19	22.09	22	25.58
5	11	12.80	10	11.63	7	8.14	13	15.12
TOTAL	86	100	86	100	86	100	86	100

Table O.

Frequencies of Ratings Given to Fifth Graders on

1) Curiosity, 2) Inventiveness, 3) Critical Thinking, and 4) Persistence

Ratings	Curiosity		Inventiveness		Critical Thinking		Persistence	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	8	10.13	7	8.86	6	7.59	10	12.66
2	22	27.85	17	21.52	18	22.78	16	20.25
3	26	32.91	27	34.18	27	34.18	24	30.38
4	17	21.52	20	25.31	24	30.38	19	26.05
5	6	7.59	8	10.13	4	5.06	10	12.66
TOTAL	79	100	79	100	79	100	79	100

Table P.

Frequencies of Ratings Given to Sixth Graders on

1) Curiosity, 2) Inventiveness, 3) Critical Thinking, and 4) Persistence

Ratings	Curiosity		Inventiveness		Critical Thinking		Persistence	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	5	6.33	4	5.06	6	7.60	8	10.12
2	15	18.99	11	13.93	12	15.19	11	13.93
3	28	25.31	32	40.51	30	37.97	29	36.71
4	20	25.31	23	29.11	22	27.85	17	21.52
5	11	13.93	9	11.39	9	11.39	14	17.72
TOTAL	79	100	79	100	79	100	79	100

Frequencies and percentages of those who received higher than average (i.e. a rating greater than 2.5) were computed and reported in the following tables.

Table Q.

Frequencies and Percentages of Higher than Average on Curiosity by Grade Level

Grade	Frequency	Percentage
1	62	71.26
2	68	71.58
3	65	70.00
4	62	71.26
5	68	71.58
6	65	69.89

Table R.

Frequencies and Percentages of Higher than Average Ratings on Inventiveness by Grade Level

Grade	Frequency	Percentage
1	64	73.56
2	65	68.42
3	61	65.59
4	60	69.77
5	55	69.62
6	64	81.01

Table S.

Frequencies and Percentages of Higher than Average Ratings on Critical Thinking by Grade Level

Grade	Frequency	Percentage
1	57	65.52
2	65	68.42
3	56	60.22
4	56	65.12
5	55	69.62
6	61	77.22

Table T.

Frequencies and Percentages of Higher than Average Ratings on Persistence by Grade Level

Grade	Frequency	Percentage
1	59	67.82
2	70	73.68
3	62	66.67
4	51	59.30
5	53	67.09
6	60	75.95

5.8 Findings.

For the convenience of readers the findings from data reduction and analyses are specified in this section without any technical aspects. For the purpose of evaluating the impact of the program the cognitive objectives were stated in two formats. One sought to compare achievements of pilot students with the achievements of control students. The other sought to determine the percentage of pilot students who reached a predetermined level of achievement. The attitudinal and skill objectives were stated only in terms of percentage achieving a predetermined level of the attitude or skill involved.

Relative to the cognitive outcomes, 1st, 2nd, 3rd and 5th grades in pilot schools surpassed significantly the performance of comparable control students. 4th and 6th graders in the pilot schools showed only slight increase over the achievement of control 4th and 6th graders. An attenuating factor here is that the pilot students in 4th and 6th grades were much below the control students in their initial knowledge of environment. Therefore it should be stated that the program has been successful even in the case of 4th and 6th graders in so far as the program succeeded in making up the deficiencies in the pilot students and in enhancing the knowledge of pilot students over that of control students though to a small degree.

Relative to attitudinal outcomes, three grades were fairly close to the expected mark -- some surpassed the mark and some fell slightly below. In every grade the expected outcome was that 75% would receive better than average ratings on a rating scale designed to measure attitude factors of curiosity, inventiveness, critical thinking and persistence. In general, the ratings on curiosity were higher for all grades than in other areas.

In addition to improvement of the scientific attitude, the students in pilot schools developed an awareness of the need for and interest in preserving our environment. Teacher remarks such as the following bear evidence to this development.

"They (students) are careful now not to litter."

"They also pick up litter found in school campus."

"They voluntarily mention the condition of yards and roads on the way to school regarding appearance."

"They tell of family discussions concerning environment."

A formal assessment of the skill objectives did not materialize. However, the teachers feel a great majority of the students are able to do the tasks specified in the skills objectives.

6.0 CONCLUSIONS AND RECOMMENDATIONS

This evaluation report has presented brief descriptions of:

1. the context in which the project was planned and implemented;
2. the components of the project (Curriculum Development, Teacher Training, Instruction and Community Involvement) and
3. the differential gains the pilot students made in knowledge and acquisition of favorable attitudes and skills relative to the preservation of our environment.

The economic and population growth of the island with the attendant environmental problems pointed to a need for environmental education in the public schools of Guam. The proposal stipulated adaptation of an existing curriculum, training for teachers in the use of the curriculum, and instruction in grades one to six in two schools with community involvement in the various phases of implementation. The Science Curriculum Improvement Study (SCIS), originally developed by the University of California at Berkeley, was adapted to suit the particular needs of Guam and was field-tested in Tamuning and Mongmong/Toto Elementary schools. The teachers involved had successfully completed a special training program in environmental education at the University of Guam. Attempts were made to involve various segments of the island community, including the military in all phases of project implementation. Evaluation data from tests and rating scales were gathered, summarized and analyzed with appropriate statistical procedures. The results showed that the pilot students made greater improvements than the control students relative to cognitive and affective objectives.

On the basis of the results of the Environmental Education for Guam Schools Program that was implemented in two schools in grades 1-6, the author of this report recommends:

1. The program be continued.
2. The program be extended to other schools and more grades.
3. The program should include projects of student involvement.
4. A system of student achievement monitoring be devised and teachers be trained to use the system.
5. Additional measures of interest and responsibility in Environment be included in assessing the affective outcomes.
6. A check list of skills be developed for each grade level and used in the assessment of student acquisition of the skills.

APPENDIX I

Following is the program overview in the revised-for-Guam teachers' guides. It should perhaps be pointed out that the Mainland SCIS material is a physical science-life science program. The EEGSP was approved to develop a curriculum in environmental science only and thus did not concern itself with physical science unless directly related to ecology.

The first year. The unit, Organisms, has certain objectives: to sharpen the students' powers of observation, discrimination, and accurate description. The objectives are accomplished as students care for aquatic plants and animals and raise seedlings.

ORGANISMS. Children become familiar with some of the requirements for life as they set out seeds and watch the growth of plants. This experience is extended when the class builds aquaria with water plants, fish, and snails. Three natural events occurring in the aquaria are observed and discussed: birth of guppies and appearance of snail eggs, growth of guppies and snails, and death of organisms.

When they explore the school yard, nearby park, or nature area, children discover plants and animals living outside the classroom. Your students are led to the concept of habitat as they compare these land organisms with those living in the aquaria.

After a few weeks, the algae in some of the aquaria increase in sufficient numbers to make the water green. The children usually notice this change and sometimes ask about its cause. Through a series of experiments and observations they recognize the presence of tiny green plants called algae. Children may then find evidence that algae are eaten by Daphnia, (water fleas). When they discover that guppies feed upon Daphnia, the children can use this series of observations as the basis for understanding the concept of a food web depicting feeding relationships among organisms.

Detritus, the black material accumulating on the sand in aquaria after a few weeks, is a combination of feces and dead plants and animals. Children infer, as they compare seeds grown in sand with and without detritus, that it acts as a fertilizer, enhancing plant growth.

Each experience with living organisms should increase the child's awareness of differences between living organisms and non-living objects.

The second year. The second year unit is Life Cycles, in which the theme is change, observed as the development of animals and plants. The unit therefore requires students to add the mental process of interpreting evidence to the observational skills develo[ped] in the first year.

LIFE CYCLES. The investigation of ecosystems begun in Organisms is continued in Life Cycles. The unit, however, focuses on individual organisms, which alone show the characteristics of the phenomenon we call "life". At this time the interrelationships and interdependencies within the ecosystem have secondary importance.

Each kind of plant and animal has its own life cycle. By studying the life cycles of selected plants and animals, children observe the characteristics of living organisms. Seeds are planted and their germinations observed. Plants are cared for until they reach maturity, produce flowers, and form a new generation of seeds. The fruit fly, toad, and beetle are observed while they metamorphose (change body form). As one generation of organisms produces another, children are led to consider biotic potential and the effects of reproduction and death on a population. Finally, when some of the similarities and differences between plants and animals have been considered, and children have defined the two categories on the basis of their own observations, they proceed to the more general question, "What is alive?" With each experience, a child's awareness of the differences between living and nonliving objects should increase.

The third year. Students observe and experiment with increasingly complex phenomena and move toward understanding the ecosystems concept. In Populations they observe the interactions of various organisms within a community of plants and animals and consider the interdependence of individuals and populations within the community.

POPULATIONS. In this unit attention is directed toward populations of organisms rather than toward individual plants and animals. Children observe the growth, eventual leveling off, and decline of isolated populations of Daphnia, aphids, and fruit flies. They relate increased population sizes to reproduction and population decline to death.

The children build aquaria and terraria in which several populations live together. The aquaria contain populations of Daphnia, hydra, snails, algae, duckweed, and Anacharis. The terraria contain grass, clover, crickets, and chameleons. By observing the interacting populations in the aquaria and terraria, the children gain some understanding of the relationships among populations in nature. For example, the children observe that hydra eat Daphnia, with the result that the Daphnia population declines while the hydra population may increase. In the terraria, the children observe that crickets eat grass and clover and that when chameleons are added to the terraria they eat the crickets. Thus, the grass and clover populations are reduced, and the cricket population is eventually wiped out.

The fourth year. In the life science unit Environments students consider for the first time some of the physical conditions that shape an organism's environment. It is important that the students be able to describe the changes they see with increased precision so they may deal more effectively with such topics as behavior of organisms and their own spatial environment.

ENVIRONMENTS. The terraria children design and build at the beginning of the unit reflect their preconceptions regarding the needs of organisms. As a result, there is a wide disparity in the growth and survival of the organisms living in the terraria, and these differences can be correlated with variations in environmental factors such as temperature, amount of water, and intensity of ligh- The term environment is defined as the sum total of all the environmental factors affecting an organism.

Afterwards, the children seek to determine the responses of individual kinds of animals and plants to variations in the environmental factors. On the basis of experiments with isopods in a runway with graded temperature, the concepts of a temperature range and of an optimum range for that animal are introduced. In additional experiments, your pupils attempt to determine optimum ranges of other environmental factors for snails, beetles, beans, grass, and clover. Before the unit is concluded, the children again construct terraria, but now they use their data on optimum ranges to plant a more favorable environment for their organisms.

The fifth year. The conceptual development of the SCIS program continues as examples of food (energy) transfer are introduced. Students apply interpretation of environmental factors during the unit.

COMMUNITIES. In the Communities unit your pupils investigate the food relations within a community of plants and animals. They experiment with germinating plants, discovering that food stored in cotyledons is consumed; however, another source of food, photosynthesis, supports the plants' growth.

The children observe the feeding behavior of animals in terraria containing various plants and animals. They identify the food chains and infer the photosynthesis in green plants not only supplies food for the plants but indirectly also for the animals in the community. The children count the large number of wheat seeds eaten by crickets and the few crickets eaten by a single toad. On the basis of these data, the food pyramid is introduced.

When an animal or plant in the terrarium dies without being eaten by anotner animal, the children place the dead organism in a vial and cover it with moist soil. They observe the organism's gradual decomposition along with the appearance of mold or an unpleasant odor. The children are told that organisms that satisfy their energy needs by decomposing the bodies of dead plants and animals are bacteria and molds.

The transfer of food through a community is illustrated by means of a chart showing the food relations among plants, animals, bacteria, and molds. The plants are identified as producers, the animals as consumers, and the molds and bacteria as decomposers. The interacting producers, consumers, and decomposers in a given area constitute the community.

The sixth year. The last year of the SCIS program contains both a climax and a new beginning. The Ecosystems unit integrates all the preceding units as your students investigate the exchange of matter and energy between organisms and their environment.

ECOSYSTEMS. Through the investigations in the Ecosystems unit children become aware of the roles played by oxygen, carbon dioxide and water in the maintenance of life. When this understanding is combined with the habitat, populations, community, and other concepts introduced in the SCIS life-science sequence, the term ecosystem acquires its full meaning.

Initially, your pupils review the ideas introduced in the five earlier units by building a composite terrarium-aquarium. The organisms living in the containers represent plants, plant eaters, and animal eaters - organisms that flourish under varying environmental conditions. The ecosystem is defined as the system composed of a community of organisms interacting with its environment.

After they observe water droplets on the inside of the terrari aquaria, the children clarify the role of water in an ecosystem. The water cycle refers to the succession of evaporation and condensation of water.

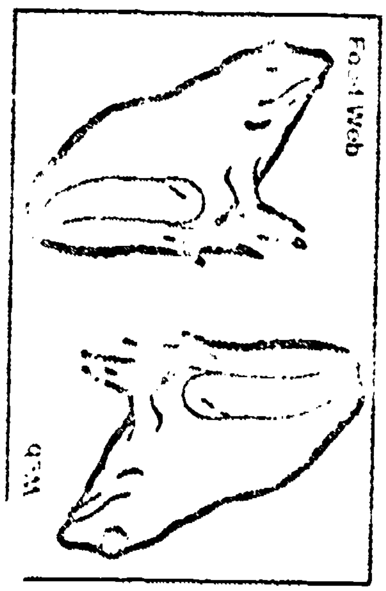
Your students study the carbon dioxide-oxygen exchange between organisms and their environment. They test their own preconceptions about oxygen and carbon dioxide when they compare the gases formed by plants exposed to light and to the dark, by animals living in a community with plants and by animals in isolation. The production and consumption of the two gases is described as the carbon dioxide-oxygen cycle.

APPENDIX II

Examples of adaptations made from mainland materials for use in Trust Territory and Guam. These are cards used in in the fifth grade program.

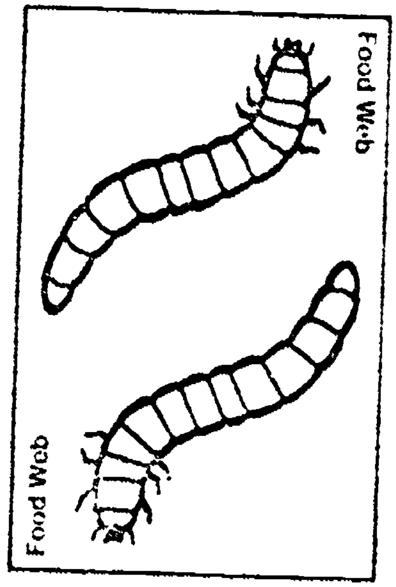
Mainland

Frogs



Frogs

Mealworms



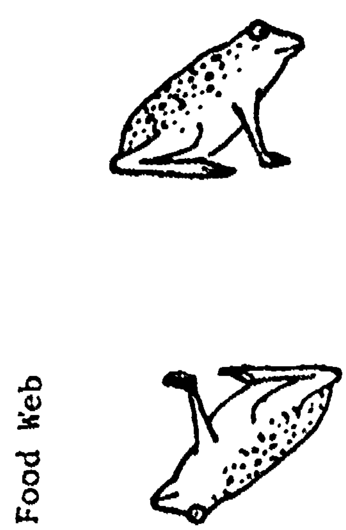
Mealworms

Trust Territory

and

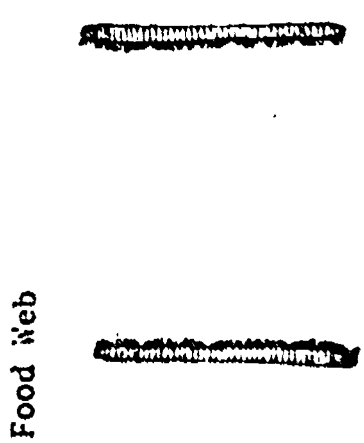
Guam

TOADS



TOADS

MILLEPEDES



MILLEPEDES

APPENDIX III

ENVIRONMENTAL CURRICULUM PROJECT FEEDBACK REPORT

DEPARTMENT OF EDUCATION, GUAM

Date____________________

Grade____________________

Teacher____________________________________ Chapter Activity #____

☐ Mongmong/Toto ☐ Tamuning

Activity Title (abbrev.)____

Comments: (Please include items such as student reactions, success of the activity in getting the objective(s) across, suggestions for improvements, etc.)